



## Preface

TiO<sub>2</sub> photocatalysis-25 years

Beginning in the early 1980s, the field of photocatalysis has grown uniformly at an overall rate of about 15% annually for new articles and reviews. The corresponding patent literature has increased at approximately the same average rate, though non-uniformly: fastest in 1993–1998 and slowest in 1983–1988 and 2003–2008 intervals. Through May, 2010, more than 40,000 articles, patents and patent applications, reviews and meeting papers have appeared, as identified by the Web of Science keyword “photocat\*.”

To celebrate this emergence and continued growth of photocatalyst literature, the 13th (now annual) International Conference on TiO<sub>2</sub> Photocatalysis: Fundamentals and Applications” chose “TiO<sub>2</sub>-25 years”, as its theme. Following the full 2008 conference, featured speakers were invited to submit papers related to their presentations, and the present issue of 14 fully reviewed papers is the result: a broad survey incorporating both new results and retrospective analyses.

The two opening papers explore photocatalyzed removal of potent biochemicals from water. First, Pelaez et al. follow destruction of microcystins using visible-light activated, doped titania, characterized by multiple techniques. Li Puma et al. apply photoreactor modeling of their experimental results to demonstrate the favorable kinetics for the photolytic vs. photocatalytic approaches for destruction of four effluent estrogens in water. Friedmann et al. survey the variety of influences acting on aqueous phase photocatalytic systems including not only adsorption and light-catalyst interactions, but also particle size and agglomeration effects. Egerton and Mattinson report on the effect of milling on activity of platinized and native photocatalysts, their findings include observation that dichloroacetic acid destruction is first order in intensity, whereas propan-2-ol disappearance varies as the square root of intensity.

Mixed reactant systems are expected to be encountered under field application conditions. Hidaka et al. studied mixed anion/cationic surfactant solutions, finding that the easily adsorbed anionic versions degrade much faster than the marginally adsorbed counterpart cationic surfactant. Gas phase photocatalyzed oxidation of C3 hydrocarbons and C3 oxygenates are considered by Zorn and Hay, who report that reaction rate in mixtures again increases with strength of binding, as well as OH radical reactivity. Pichat discusses issues pertinent to photocatalyzed air purification: water multilayers, active oxygen species, pollutant interactions, and small organic carbonyls.

Real world catalyst challenges include catalyst deactivation, environmental impact of photocatalytic processes and intellec-

tual property. Hay and Obee report how ppb air contaminant levels of organic siloxanes can contribute, via SiO<sub>2</sub> deposition, to permanent deactivation of photocatalysts in air–solid systems. Revelli et al. execute an environmental compatibility study to compare thermal vs. photocatalytic functionalization of heterocyclics, demonstrating substantial remaining challenges for the photocatalyzed process route. The record of patent and patent application evolution is reported by Paz, finding that while academic papers emphasize water treatment vs. air remediation, the patent literature displays the converse: stronger interests in air treatment vs. water.

Catalyst fundamentals are revisited in the final four papers. Fittschen et al. demonstrate production of hydroperoxyl (HO<sub>2</sub>) radicals above illuminated titania surfaces. Herrmann reminds readers that photocatalysts are a school of catalysis as well as photochemistry and are hence subject to the historically derived principles and lessons learned in both arenas. Yalçın et al. demonstrate iron-doped photocatalysts have visible light activity for 4-nitrophenol photo-oxidation, and show via parallel modeling via DFT the possible effect of iron substitution in titania clusters, finding additional electronic states arising in the titania bandgap.

Finally, Ollis creates simple kinetic models for kinetics on self-cleaning photocatalytic surfaces, showing their quantitative applicability to removing several pollutant layer types: long chain fatty acids, sulfur, and soot particles.

The editors hope that readers find these timely as well as reflective papers to represent a snapshot of the continually increasing activity in heterogeneous photocatalysis. We thank the contributors and reviewers, as well as the Elsevier editorial staff, for the creation of this issue of Applied Catalysis.

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Available online 25 June 2010